

Encoder Interface with Initiator Input

Intended Application

This supplement describes the optional encoder interface 2M.F5-080-3007. Inverters equipped with this interface are identified by the tenth digit in the type code. The following types are possible:

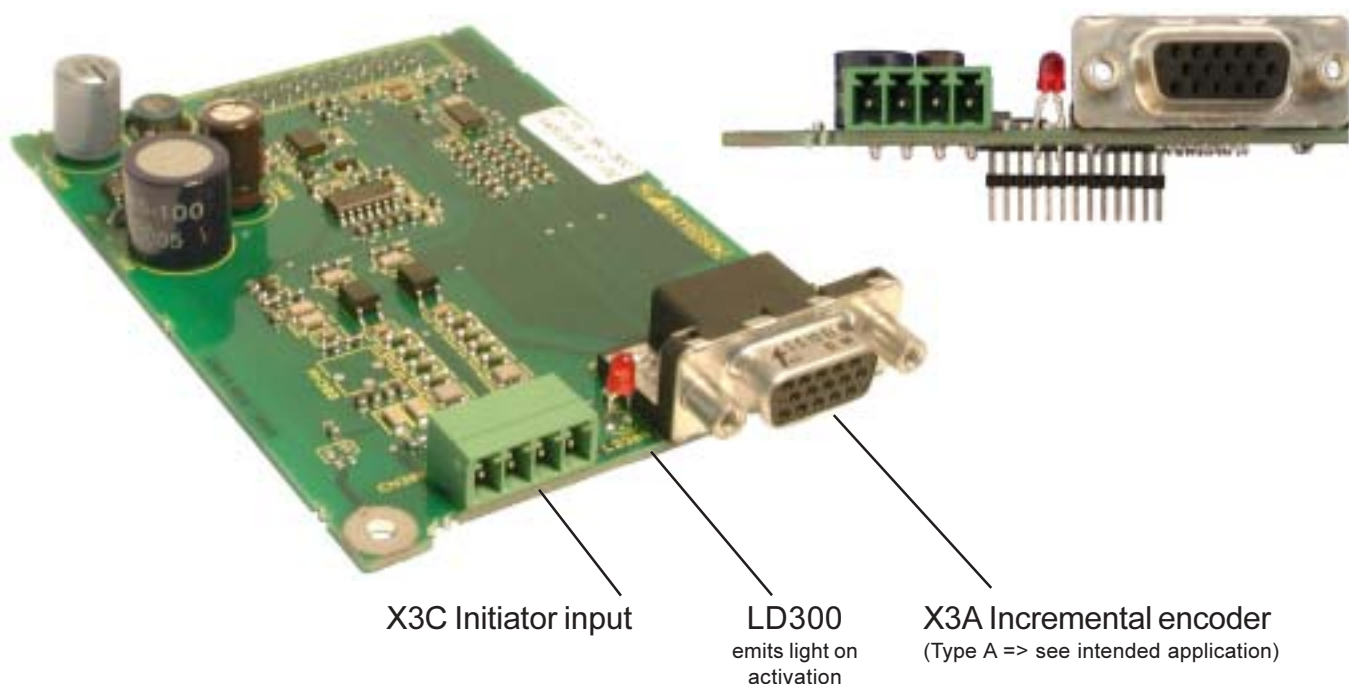
- xx.F5.xxx-xxAx Incremental encoder with initiator
- xx.F5.xxx-xxBx Resolver with initiator
- xx.F5.xxx-xxCx Hiperface with initiator

Validity

This supplement is valid only in connection with the F5-Application Manual 00.F5.xDA-Kxxx. If the encoder input 1 is a resolver and/or a Hiperface a further supplement is necessary.

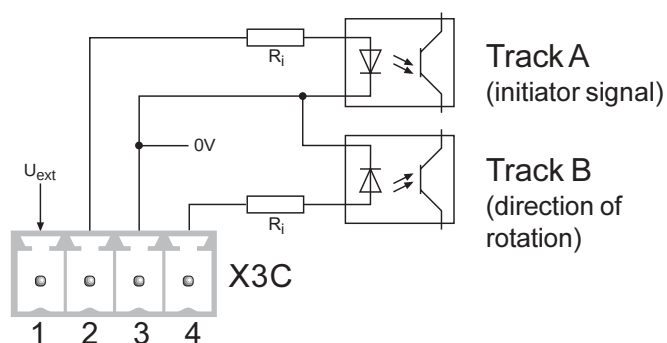
Description of Initiator Input

Interface with incremental encoder and initiator input 2M.F5-080-3007



Specification und internal circuit

- R_i : 1,9 k Ω
- U_{in} : 24 VDC $\pm 25\%$
- T_{Puls} (min.): 25 μs
- X3C.1: Voltage output U_{ext}
- X3C.2: Initiator input
- X3C.3: 0V
- X3C.4: Change of direction of rotation
0 V: clockwise rotation
24 V: anti-clockwise rotation



Selection of direction of rotation encoder 2 (Ec.16 Bit 0...2)

In the case of initiator evaluation no direction of rotation can be recorded. For that reason a positive speed (clockwise rotation) is always assumed as result. However, dependent on Ec.16 this setting can be redefined:

Ec.16	Selection of direction of rotation encoder 2
Bit 0...2	Encoder direction of rotation 0 not inverted - clockwise rotation (default) 1 inverted - anti-clockwise rotation 2 the sign of the determined speed corresponds to the sign of the output frequency 3 depending on track B (terminal X3C.4) 0 V => clockwise rotation 24 V => anti-clockwise rotation
Bit 3	System inverting 0 not inverted 1 inverted

Encoder line number 2

With this parameter the number of cams of the encoder disc is adjusted. Generally it can be said: The more cams are available, the

- finer is the speed resolution
- faster is the recording (important for short clock cycles)
- better are the control properties

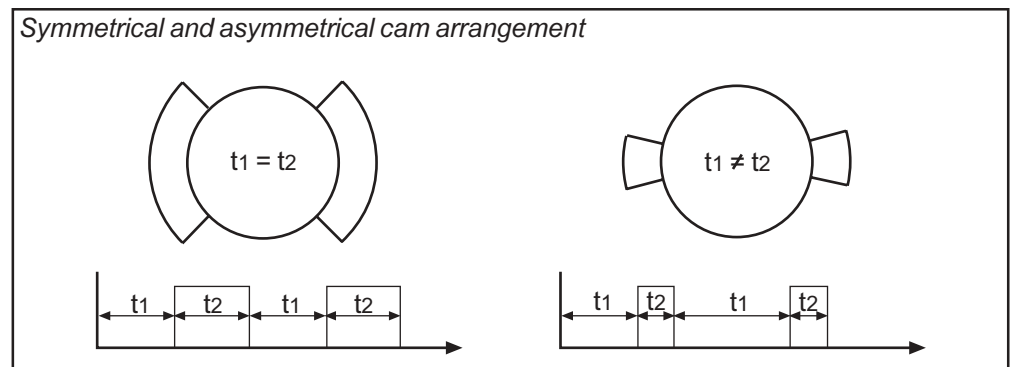
Multiple evaluation 2 (Ec.17)

The mode of evaluation is adjusted with this parameter. Two possible adjustments are available for the initiator interface:

- Single evaluation: per cam only the rising edge is evaluated; is adjusted, if **no** symmetrical pulse/pause ratio exists.
- Double evaluation: Per cam the rising and the falling edge are evaluated. If a symmetrical pulse/pause ratio exists, a higher resolution is achieved with the double evaluation which results in a better control.

Ec.17	Multiple evaluation 2
0	single
1	double
2...13	reserved

Symmetrical and asymmetrical cam arrangement



! If in spite of asymmetrical pulse/pause ratio the double evaluation is adjusted, it leads inevitably to speed fluctuations.

**Speed scan time 2
(Ec.13)**

The speed scan time for the initiator input is determined with Ec.13. Within the adjusted time the initiator signals are recorded and used for the calculation of the speed control.

Ec.13	Value	dec.	0	1	2	3	4	5	6	7	8	9
	Time	[ms]	0,5	1	2	4	8	16	32	64	128	256

The adjustment of the speed scan time strongly depends on the application. Generally it can be said:

- the longer the scan time is adjusted, the more pulses are evaluated and the more accurate is the speed control
- the shorter the speed scan time is adjusted, the faster reacts the speed control but it is more inaccurate (particularly important with short cycle times of the machine)

**Evaluation of Initiator
Signals**

Following formula is used as calculation basis for the application of initiators.

$$\Delta n [\text{min}^{-1}] = \frac{60000}{\text{Ec.17} \cdot \text{Ec.11} \cdot \text{Ec.13}}$$

$\Delta n [\text{min}^{-1}]$: Speed resolution in revolutions per minute (accuracy)
 60000: Conversion factor from 1/ms to 1/min
 Ec.17: Enter 1 for single evaluation; 2 for double evaluation
 Ec.11: Number of cams
 Ec.13: Speed scan time in ms

Example

A speed accuracy of 20 min^{-1} is demanded. A cam number at the initiator of 50 with symmetrical arrangement is specified.

$$\begin{aligned} \Delta n &= 20 \text{ min}^{-1} \\ \text{Ec.17} &= 2 \\ \text{Ec.11} &= 50 \end{aligned}$$

$$\text{Ec.13} = \frac{60000}{\text{Ec.17} \cdot \text{Ec.11} \cdot \Delta n} = \frac{6000}{2 \cdot 50 \cdot 20} = 30 \text{ ms}$$

$$\Rightarrow \text{adjustment Ec.13} = 6 \hat{=} 32 \text{ ms}$$

Additional requirement

The drive shall reach the maximum speed n_{max} with an acceleration time t_{ACC} of 200 ms!



A satisfactory regulation is achieved, if the change of actual value is ten times faster than the change of setpoint value.

This means for the above mentioned example:

$32 \text{ ms} \cdot 10 < t_{\text{ACC}}$, the outcome of this is, that this application with the specified additional requirement will not have good control properties.

New calculation

With a scan time of 16 ms we could fulfil the additional requirement.

$$\text{Ec.11} = \frac{60000}{\text{Ec.17} \cdot \text{Ec.13} \cdot \Delta n} = \frac{6000}{2 \cdot 16 \cdot 20} = 93,75 \text{ Increments}$$

For the plant in the example another cam disk with a least 94 cams would have to be used.

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